



Contents lists available at ScienceDirect

Taiwan Journal of Ophthalmology

journal homepage: www.e-tjo.com

Case report

Management of keratoconus and post-laser-assisted *in situ* keratomileusis ametropia and keratectasia with mini-scleral lenses—Three case reportsChia-Chin Liao^a, Jen-Chieh Lin^{a,b,*}^a Department of Ophthalmology, Taipei City Hospital, Heping Fuyou Branch, Taipei, Taiwan^b Graduate Institute of Epidemiology and Preventive Medicine, College of Public Health, National Taiwan University, Taipei, Taiwan

ARTICLE INFO

Article history:

Received 13 November 2013

Received in revised form

18 March 2014

Accepted 19 March 2014

Available online 10 May 2014

Keywords:

ametropia

keratoconus

keratectasia

mini-scleral lens

ABSTRACT

The aim of this study was to report cases that had used mini-scleral lenses to manage keratoconus and post-laser-assisted *in situ* keratomileusis (LASIK) ametropia and keratectasia. The first patient was a 32-year-old man who came to our clinic seeking to correct his vision. Following the LASIK procedure, his refraction gradually shifted toward hyperopia. He initially tried wearing spectacles and traditional rigid gas permeable (RGP) lenses, neither of which showed improvement. The second patient was a 28-year-old woman who complained of gradually worsening vision in her right eye after having received LASIK. She was diagnosed with corneal ectasia after a complete ophthalmic examination. She tried wearing spectacles and soft contact lenses, but neither showed any improvement. The third patient was a 29-year-old man with a long history of poor vision. He was first diagnosed with keratoconus in our clinic. He initially tried wearing a Rose K contact lens for the keratoconus in his right eye, but the lens rode low. After the initial treatment attempts, all three patients tried mini-scleral lenses, and their visual acuity improved to between 20/50 and 20/20. They were all able to wear the lenses for more than 10 hours a day without feeling any discomfort. In conclusion, mini-scleral lenses provide better comfort and vision in patients with keratoconus and post-LASIK keratectasia and ametropia.

Copyright © 2014, The Ophthalmologic Society of Taiwan. Published by Elsevier Taiwan LLC. All rights reserved.

1. Introduction

Corneal abnormalities, such as corneal ectasia, severe dry eye, and exposure keratopathy, can reduce visual acuity because of irregular astigmatism or ocular surface disease. Patients with such issues may be treated without surgery by using scleral lenses.¹

Scleral lenses play an important role in the treatment of these corneal diseases, a fact that has been shown by several publications to date.^{1,2} Scleral lenses are typically categorized into traditional scleral lenses, which have a diameter >18 mm, and mini-scleral lenses, which are between 14.0 mm and 18.0 mm. Mini-scleral lenses have a number of advantages over traditional corneal and scleral lenses, such as offering a higher degree of patient comfort³ and fewer challenges for physicians during the fitting process.

The series of cases presented here show how mini-scleral lenses can improve the quality of life and vision for patients with different corneal diseases.

2. Case reports

2.1. Case 1

A 32-year-old man came to our clinic seeking to correct his vision. The patient had undergone bilateral laser-assisted *in situ* keratomileusis (LASIK) in 2009. His pre-operation refraction was −5.75 diopters (D) in his right eye (OD) and −6.00 D in his left (OS). He complained of blurred vision, eye strain, photophobia, and headaches, especially when reading. His best corrected distance visual acuity (BCVA) was 20/30 with a refraction of +1.75−0.25 × 85° OD and 20/30 with a refraction of +2.25−0.25 × 140° OS. The refraction was +0.75D OD and +1.00D OS 1 year after LASIK surgery. He initially wore spectacles to correct his vision, but blurred vision and headaches persisted when he studied. He also felt dizzy when walking and occasionally experienced cold sweats. He gave up on

Conflicts of interest: All authors declare no conflicts of interest.

* Corresponding author. Department of Ophthalmology, Taipei City Hospital, Heping Fuyou Branch, Number 33, Section 2, Chung-Hwa Road, Taipei City 10065, Taiwan.

E-mail address: jclin54@yahoo.com.tw (J.-C. Lin).

<http://dx.doi.org/10.1016/j.tjo.2014.03.003>

2211-5056/Copyright © 2014, The Ophthalmologic Society of Taiwan. Published by Elsevier Taiwan LLC. All rights reserved.

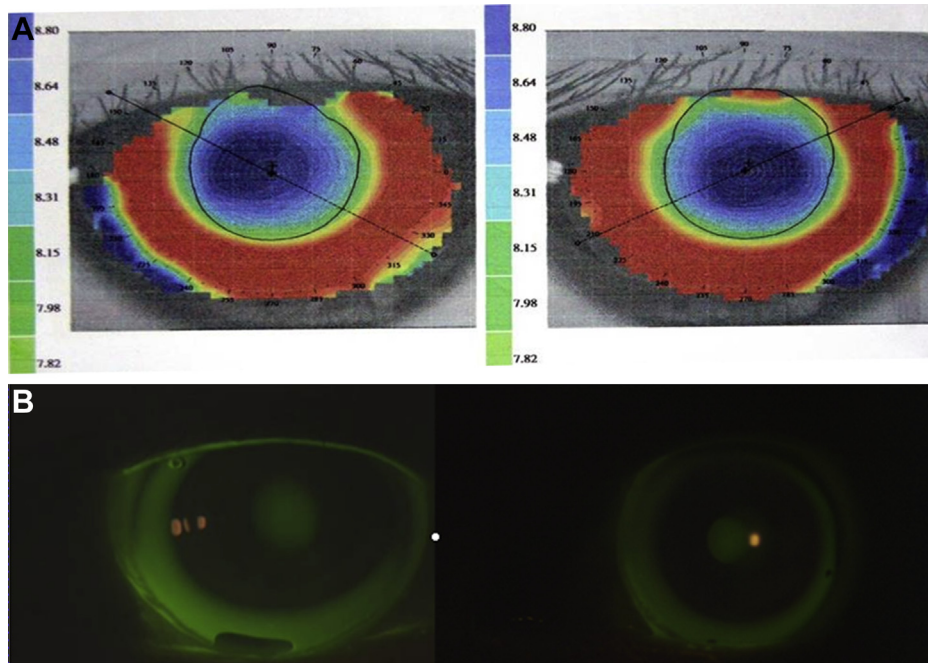


Fig. 1. (A) Topography of bilateral post-laser-assisted *in situ* keratomileusis (post-LASIK) eyes; and (B) demonstration of mini-scleral lens fit: an ideal fit without central touching and a minimal amount of central corneal clearance.

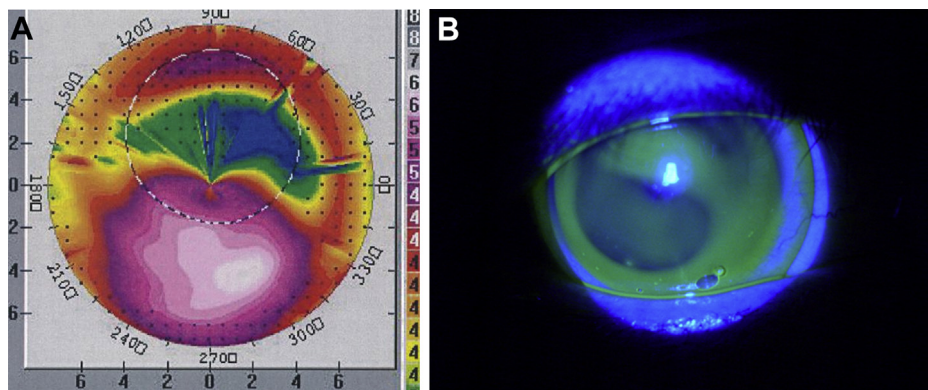


Fig. 2. (A) Topography reveals right corneal inferior and central steepening; (B) a feather touch is present inferocentrally and pooling is present superiorly due to keratoconus; the small inferior bubble is likely due to insufficient saline in the lens.

the spectacles and instead tried traditional rigid gas permeable (RGP) lenses. The symptoms improved, but an intolerable foreign-body sensation was noted in both his eyes. Then he tried mini-scleral lenses. Initially, a standard design with a base curve (BC) of

7.42 mm in 15 mm diameter lenses was tried in both eyes, but central pooling and an absence of limbal clearance could be seen with fluorescein staining. Thus, we then tried lenses with the BC increased to 7.60 mm, which achieved good cornea clearance.

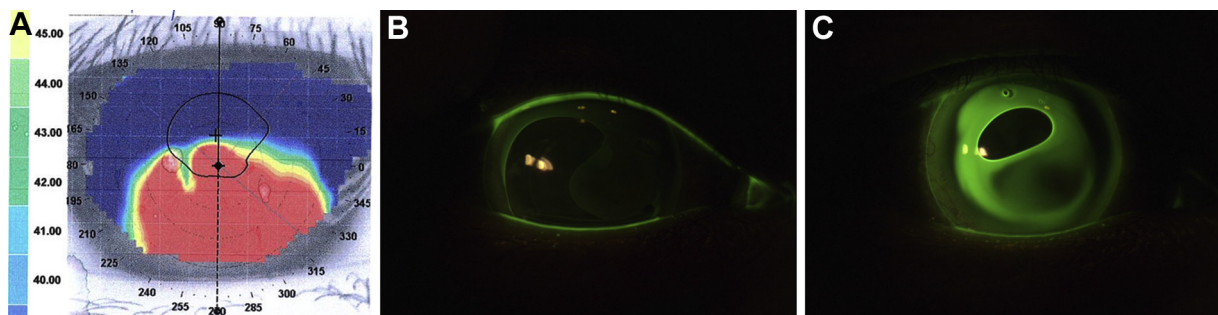


Fig. 3. (A) A keratoconic eye exhibits the typical topographic pattern of an asymmetric bow tie with a skewed radial axis; (B) a large air trapping is present due to the base curve of the mini-scleral lens being too flat; (C) a smaller air trapping with pooling is present for a mini-scleral lens with cone design.

Final lens order: OD: BC: 7.60 mm/–5.00 D/periphery curve: 7.65 mm/total diameter: 15.00 mm OS: BC: 7.60 mm/–6.50 D/periphery curve: 7.65 mm/total diameter: 15.00 mm.

These lenses fit reasonably well without any discomfort. His BCVA was 20/20 in both eyes after 1 month of wearing the mini-scleral lenses. His corneas were clear without keratitis. After 1 year of follow-up, his visual acuity was 20/20 in both eyes with the lenses. A slit lamp examination revealed clear corneas without keratitis. He could tolerate wearing the lenses for >10 hours a day (Fig. 1A and B).

2.2. Case 2

A 28-year-old woman came to our clinic complaining of gradually worsening vision in her right eye 3 years after a bilateral LASIK procedure. She underwent a complete ophthalmic evaluation with an uncorrected distance visual acuity (UCVA) assessment, corneal topography, corneal pachymetry, and a slit lamp examination of the anterior and posterior segments of her eyes. Her UCVA was 20/40 OD. The slit lamp examination showed inferior central corneal thinning and an iron line in her right eye. Her corneal topography revealed marked right inferior steepening, with a maximal power of approximately 62.00 D. She tried wearing a mini-scleral lens in her right eye. The first attempted lens fitting provided her with aspheric cone design lenses with BC 7.40 mm and a diameter of 14.5 mm, but we discovered a central touch with lens movement >2 mm. In the second attempt, the BC was reduced to 7.13 mm, but we still found similar results. The BC was then reduced again to 7.03 mm, and central clearance was good (0.2 mm), but we found an increasing limbal clearance with a peripheral air bubble. Finally, lenses were switched to BC 6.88 mm, which obtained clear improvement (Fig. 2A and B).

Final lens order: OD: BC: 7.03 mm/–15.00 D/periphery curve: 6.88 mm total diameter: 14.50 mm.

After 1 year of follow-up, her visual acuity was 20/25 OD with the lens. A slit lamp examination revealed mild superficial keratitis in the inferocentral cornea. She could tolerate wearing the lens for >10 hours a day.

2.3. Case 3

A 29-year-old man, an engineer, had been experiencing poor vision for a long time, but he ignored it because he thought it was due to eye strain. However, the symptoms never improved, so he visited our clinic. His UCVA values were 20/400 OD and 20/20 OS. His topography showed irregular astigmatism OD. Topographies also revealed right corneal inferior steepening, with a maximal power of approximately 50.00 D, which suggested corneal ectasia (Fig. 3A). Keratoconus had not been discussed with the patient during previous examinations.

He initially tried a Rose K contact lens for his keratoconus, but the lens rode low. The BCVA was 20/200 OD. He then tried a mini-scleral lens. He was first fitted with standard design lenses with BC 7.35 mm and a diameter of 14.5 mm, but fluorescein revealed a high degree of air trapping (Fig. 3B). We then switched to an aspherical cone design with BC 6.49 mm and diameter of 14.5 mm. Fluorescein staining still revealed significant air trapping, although there was also clear improvement (Fig. 3C). We then reduced the BC to 6.37 mm, and the air trapping disappeared, at which point his vision reached 20/50 OD.

Final lens order: OD: BC: 6.37 mm/–14.00 D/periphery curve: 6.37 mm/total diameter: 14.50 mm.

After 1 year of follow-up, his visual acuity was 20/50 OD with the lens. A slit lamp examination revealed mild keratitis over the

Table 1
Summary of fitting process of three patients.^a

Patient no.	1										2										3									
	OD					OS					OD					OD					OD									
Fitting no.	1	2	Standard	Standard	Final	1	2	Standard	Standard	Final	1	2	3	4	Final	1	2	3	4	Final	1	2	3	Final						
Design	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Cone	Cone	Cone	Cone	Cone	Standard	Cone	Cone	Cone	Cone	Standard	Cone	Cone	Cone						
Base curve (mm)	7.42	7.60	7.60	7.60	7.60	7.42	7.60	7.60	7.60	7.60	7.40	7.13	7.03	6.88	7.03	7.35	6.49	6.37	6.37	7.03	7.35	6.49	6.37	6.37						
Diameter (mm)	15	15	15	15	15	15	15	15	15	15	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5						
Peripheral curve (mm)	—	—	—	—	7.65	—	—	—	—	7.65	—	—	—	—	6.88	—	—	—	—	6.88	—	—	—	6.37						
Refraction (diopter)	—	—	—	—	−5.00	—	—	—	—	−6.50	—	—	—	—	−15.00	—	—	—	—	−15.00	—	—	—	−14.00						
Corneal clearance (mm)	0.5	0.2	0.2	0.2	0.2	0.5	0.2	0.2	0.2	0.2	Absent	<0.1	0.2	0.3	0.2	>0.5	0.3	0.2	0.2	0.2	>0.5	0.3	0.2	0.2						
Limbal clearance (mm)	Absent	Absent	Absent	Absent	0.1	Absent	Absent	Absent	Absent	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1						
Conjunctival indentation	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent						
Lens movement (mm)	1	2	2	2	2	1	2	2	2	2	3	3	2	2	2	3	2	2	2	2	3	2	2	2						
Trapped air bubbles	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Severe*	Moderate*	Absent	Absent	Absent	Severe*	Moderate*	Absent	Absent						

^a Trapped air bubbles: moderate, >2 mm to <4 mm in diameter; severe, >4 mm in diameter.

inferior cornea. He could tolerate wearing the lens for >10 hours a day.

A summary of the lens fitting process for the three patients is described in Table 1.

3. Discussion

The designation of mini-scleral lens includes three to four curves, which are the BC, secondary, or intermediate curve, and peripheral curve. An ideal mini-scleral lens fitting shows light alignment to minimal apical corneal clearance, with no compression of the limbus and no conjunctiva indentation. Lens movement when blinking should be minimal both for good stability and patient comfort.⁴

In this study, we reported the results of mini-scleral lens fittings for three patients with a variety of corneal conditions. From our experience with mini-scleral lens fittings, many patients with post-LASIK ametropia or irregular cornea, similar to those mentioned in this paper, used to wear RGP lens but gave them up because of discomfort. Wearing RGP lenses in advanced keratoconic cases can be difficult because of lens decentration, dislocation, and even recurrent apical erosions due to corneal touch.⁵ Traditional scleral lenses may correct the shortcomings of RGP lenses; however, such lenses may also cause discomfort or pain, a noticeable foreign body sensation, or handling difficulties during insertion and removal of the lenses.⁶ Furthermore, we discovered that the majority of such patients may also develop an atopic, allergic constitution or meibomian gland dysfunction. Because of bad tearing conditions, wearing RGP lenses can be very difficult and even more uncomfortable.⁷ Therefore, we decided to try using mini-scleral lens for these three patients. Mini-scleral contact lenses with overall diameters of 14–18 mm were first described in the late 1990s.⁸ Mini-scleral lenses provide patients with the optical advantages of RGP lenses, but with comfort and tolerance levels approaching those found with soft contact lenses, because of their large overall diameters.⁹ Furthermore, mini-scleral lenses are often more comfortable for patients during fitting and are more accepted than traditional scleral lenses given their smaller diameters.

During the fitting process, we tried to choose the lens by using patients' average K values for initial fitting. However, for post-LASIK patients or those with cornea ectasia or irregular cornea, their average K values are measured by an auto refractometer, which cannot represent the corneal curvature as a whole. Therefore, we had to refer to topography data and then gradually made adjustments based on cornea clearance, limbal clearance, and conjunctival indentation during the fitting process. We used a slit lamp optical section to measure the corneal and limbal clearance and

gauged the fit by swinging our slit beam out 45–60° and observing the tear layer in the cross section. We compared the thickness of the tear layer with the cornea thickness at approximately 0.5–0.6 mm. Limbal clearance is harder to compare to cornea thickness, thus, we used the already known contact lens thickness (0.2 mm) as a reference.

For the second patient with post-LASIK keratectasia and the third one with keratoconus, we used the cone design to avoid cornea touching or air trapping caused by irregular cornea. However, determining the optimal BC with these lenses can be a challenge for patients with irregular cornea surface. To prevent air trapping, a physician may opt for a flatter BC, but this can possibly result in increased corneal touching, causing inflammation of the cornea, as well as increased lens movement. If a steeper BC is selected to avoid this situation, air trapping may sometimes be unavoidable. The choice may result in either increased patient discomfort or decreased visual quality. In this situation, fitting choices should be made with consideration for both patient comfort and vision.

In conclusion, mini-scleral lenses may be an option for optimizing comfort and visual quality among patients with ocular surface damage and high amounts of astigmatism. In patients with severe ocular surface disease, mini-scleral lenses may assist in rehabilitating the ocular surface and can be used to determine the optimum vision potential. In this case series, mini-scleral lenses provided improvement in comfort and vision in a keratoconic patient and patients with post-LASIK keratectasia and ametropia.

References

1. Ramero Rangel T, Stavrou P, Cotter J. Gas-permeable scleral contact lens therapy in ocular surface disease. *Am J Ophthalmol*. 2000;130:25–32.
2. Visser E-S, Visser R, van Lier HJJ, Otten HM. Modern scleral lenses. Part I: clinical features. *Eye Contact Lens*. 2007;33:13–20.
3. Visser E-S, Visser R, van Lier HJJ, Otten HM. Modern scleral lenses. Part II: patient satisfaction. *Eye Contact Lens*. 2007;33:21–25.
4. van der Worp EA. *Guide to Scleral Lens Fitting [Monograph Online]*. Scleral Lens Education Society; 2010. Available from <http://commons.pacificu.edu/mono/4/>; retrieved on November 11, 2013.
5. Schornack MM, Patel SV. Scleral lenses in the management of keratoconus. *Eye Contact Lens*. 2010;1:39–44.
6. Pecego M, Barnett M, Mannis MJ, Durbin-Johnson B. Jupiter scleral lenses: the UC Davis Eye Center experience. *Eye Contact Lens*. 2012;38:179–182.
7. Arita R, Itoh K, Inoue K, Kuchiba A, Yamaguchi T, Amano S. Contact lens wear is associated with decrease of meibomian glands. *Ophthalmology*. 2009;116:379–384.
8. Vreugdenhil W, Geerards AJ, Vervaeke C. A new rigid gas-permeable semi-scleral contact lens for treatment of corneal surface disorders. *Cont Lens Anterior Eye*. 1998;21:85–88.
9. Ye P, Sun A, Weissman BA. Role of mini-scleral gas-permeable lenses in the treatment of corneal disorders. *Eye Contact Lens*. 2007;33:111–113.